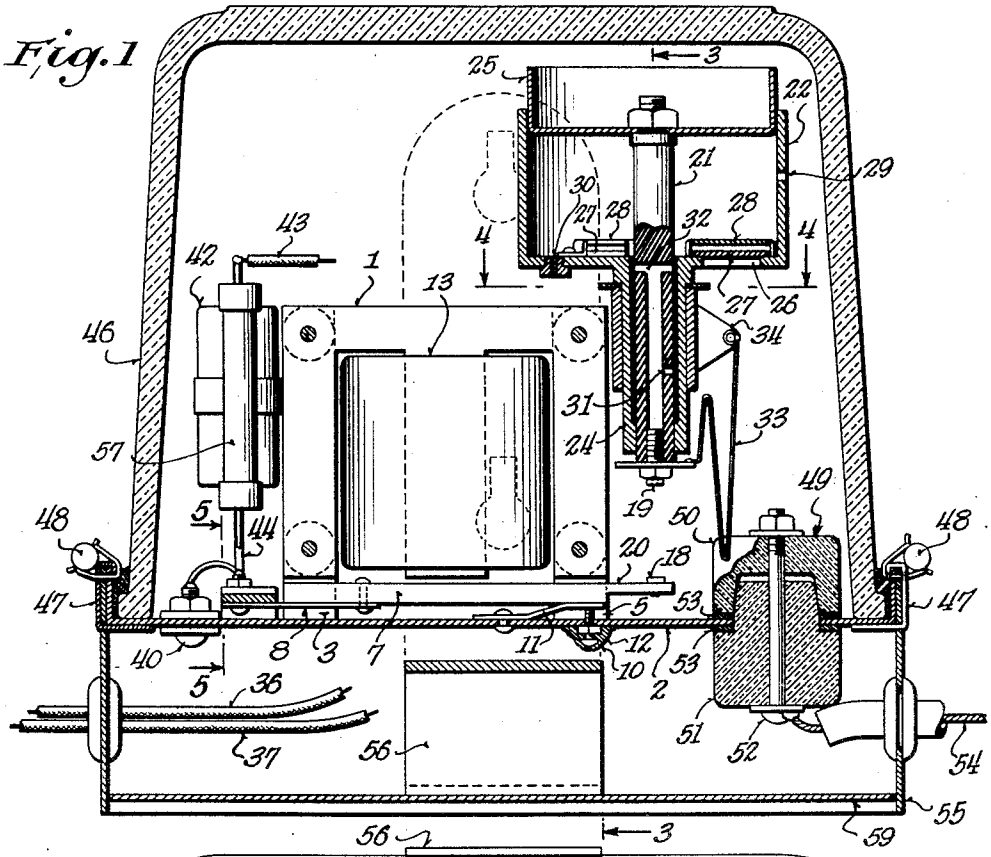
July 27, 1943. A. P. JORGENSON 2,325,249

DELAYED ACTION INTERRUPTER ELECTRIC IMPULSE APPARATUS

Filed Dec. 7, 1939 2 Sheets-Sheet 1

Fig. 1



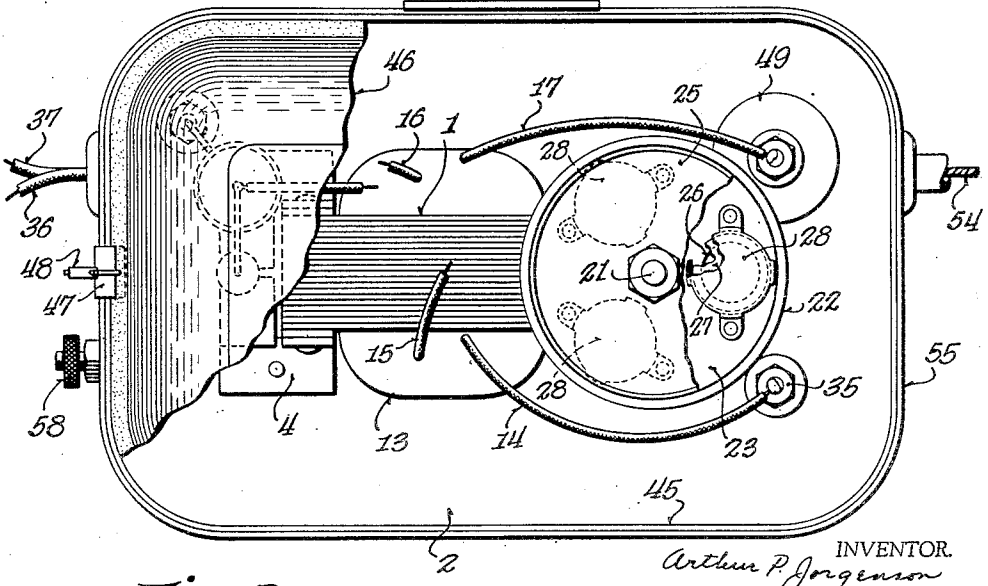


Fig. 2

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Fig. 3

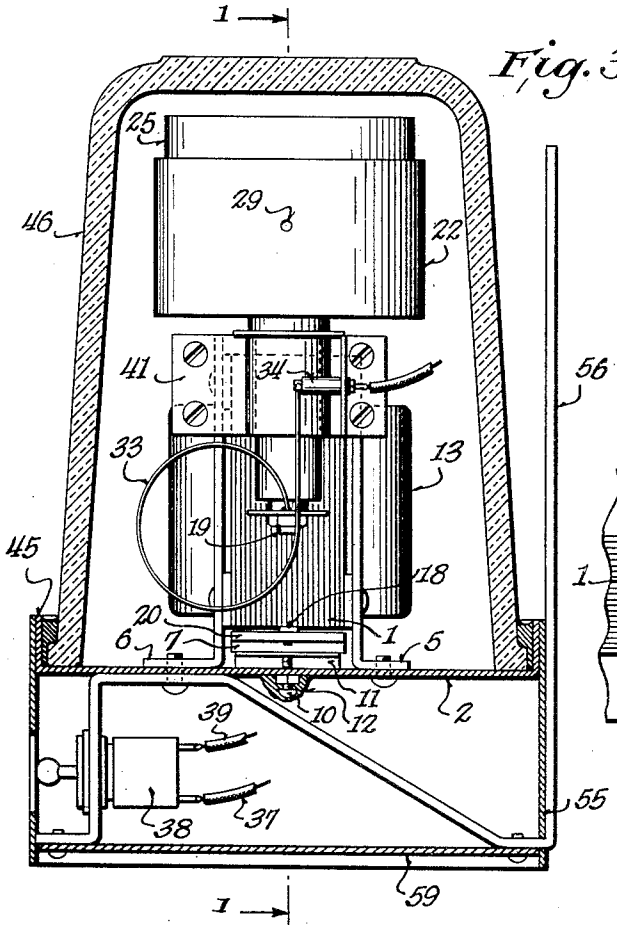


Fig. 4

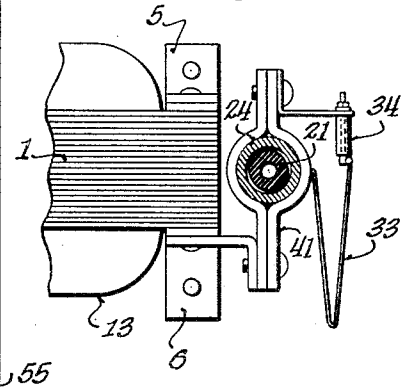
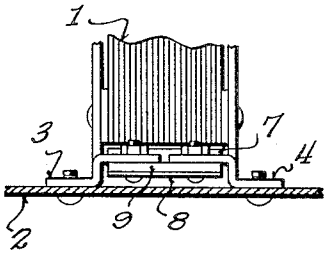


Fig. 5



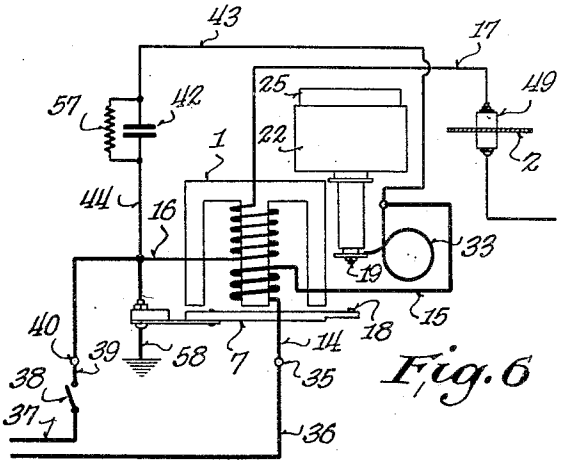


Fig. 6

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UNITED STATES PATENT OFFICE

2,325,249

DELAYED ACTION INTERRUPTER ELECTRIC IMPULSE APPARATUS

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Application December 7, 1939, Serial No. 308,003

5 Claims. (Cl. 175—365)

This invention relates to delayed action electric interrupters suitable for producing time-spaced electrical impulses at frequencies of the order of 10 to 200 cycles per minute, more or less, which rates are found useful in electric fence chargers, sign flashers, and the like, and said invention resides in an improved fluid-delayed, electromagnetically-actuated interrupter having an approximately constant frequency over a substantial range of voltage variation.

Heretofore in the art a wide variety of electromagnetically-driven interrupters have been employed to give spaced impulses, such as are required for signal and electric fence-charging service. In many of these an object has been to achieve operation with great economy of electric energy consumption and to this end various forms of balance-wheels and pendulums have been employed to produce the required spacing of impulses. Such devices may be made to operate with a very low rate of energy consumption, but difficulty is experienced in obtaining approximately constant frequency with such devices over substantial ranges of applied voltage. This is partly due to the fact that self-starting properties and good contact pressure are not obtainable with a dead-beat swing device and practically all such devices now in use employ a half-swing inertia member, which inherently exhibits a more rapid rate as the voltage falls off. Furthermore, in many such devices when excess voltage is applied, over-swing of the inertia member brings on an erratic behavior. These difficulties are more acute, due to the fact that it is often convenient or necessary to employ dry cell batteries as an energy source and the well-known characteristics of these is to furnish a declining voltage as the life of the same progresses. In an effort to overcome these difficulties the tendency has been to make the inertia members larger and heavier and in so doing the devices become cumbersome and to a certain extent the desired low energy consumption is sacrificed.

In the apparatus of this invention, however, a novel form of pneumatic or fluid-controlled stroke regulator is employed, which may be made compact without sacrificing its inherent tendency to maintain approximately constant rate of interruption over a substantial range of voltage variation and which will at all times provide adequate contact pressures. Further, the apparatus of this invention is not inclined to erratic behavior or unexpected increase in rate when excess voltage is applied.

The apparatus of this invention is herein explained and described with the aid of the accompanying drawings in which there is set forth, by way of illustration and not of limitation, one form in which the apparatus of this invention may be embodied. In the drawings:

Fig. 1 is a side elevation with parts shown in section of one form of the apparatus of this invention;

Fig. 2 is a plan view, with parts broken away, of the apparatus shown in Fig. 1;

Fig. 3 is an end elevation, in section, of the apparatus shown in Fig. 1, viewed through the plane 3—3 indicated in Fig. 1;

Fig. 4 is a detail plan view, in section, of the piston-rod and guide-sleeve of the apparatus shown in Fig. 1, viewed through the plane 4—4 indicated in Fig. 1;

Fig. 5 is a detail end elevation, in section, of the armature mount of the apparatus shown in Fig. 1, viewed through the plane 5—5 indicated in Fig. 1; and

Fig. 6 is a wiring diagram suitable for use in the apparatus of this invention.

Referring to the drawings, in which one form of the apparatus of this invention is shown, it will be noted that an open type transformer core 1, composed of laminated iron or other suitable magnetic material, is mounted upon a base 2 by means of brackets 3, 4, 5, and 6, which brackets are fastened to the base by screws, as shown. These brackets are preferably composed of brass or other nonmagnetic material to the end that the principal return flux path of core 1 may be directed through an armature 7, composed of iron or other magnetic material, disposed beneath the core 1 in the position clearly shown in Fig. 1.

The armature 7 is hingedly secured to the base 2 by means of a spring 8, spacer-block 9, inwardly-facing ears of brackets 3 and 4, and bolts which pass therethrough, as clearly shown in the detail view Fig. 5. Gravity and the tension of spring 8 tend to separate armature 7 from core 1 and the air-gap between these parts in open position is fixed by a factory-set adjustment provided for through an adjusting screw 10 which acts against a spring-rest 11, as clearly shown in Figs. 1 and 3. After desired adjustment is attained, the screw 10 and its locknut are covered with solder or other sealing substance to close any slight opening through base 2. In the drawings solder 12 is shown covering the screw 10. In like manner the screws which hold brackets 3, 4, 5, and 6 and the rivets which hold

rest 11 may be hermetically sealed with solder or other suitable cement.

Surrounding the central member of core 1 are primary and secondary windings, generally designated 13, which are employed in the apparatus. The primary winding is composed of a relatively few turns of wire of moderate gage. The leads energizing from the primary winding are shown in Fig. 2, where they are designated 14 and 15. The leads emerging from the secondary winding, which is composed of a larger number of turns of smaller gage wire, are designated 16 and 17. The manner of connecting these leads is described in full later in this description.

To control the admission of current to the primary winding a pair of periodically-engaging contacts 18 and 19 are provided. Contact 18 is directly fastened to an outward extension 20 of armature 7 and is in electrical contact therewith and with the base 2 through the spring 8 and mounting brackets 3 and 4. Contact 19, on the other hand, is movably carried through a rising and descending stroke upon a piston-rod 21 which forms a part of a stroke-regulating dashpot.

The stroke-regulating dashpot is enclosed within a cylinder 22 which is closed at the bottom by cylinder-head 23 from which there depends a concentrically positioned piston-rod guide-sleeve 24. A cylinder 22 is supported by a clamp 41 surrounding guide-sleeve 24, which clamp is fastened by screws to a lug projecting at right angles from the upper end of bracket 6, as shown clearly in Fig. 4. Mounted upon the upper end of piston-rod 21 is a piston 25 dimensioned for a slip fit in the barrel of cylinder 22. In like manner the bore of guide-sleeve 24, although substantially larger than the diameter of piston-rod 21 in its upper part, is constricted near its lower end, as shown, to engage the sides of the piston-rod 21 with a slip fit. The piston and piston-rod assembly are thus guided for rising and descending movement with little friction, the weight of the moving parts providing sufficient loading to cause the descending movement. By a system of valves and ports, however, a rapid rate of rise and a slower, regulated rate of fall of the piston and associated parts is provided. If desired, springs or other loading means may be provided to supplement or replace the weight of the moving parts.

To facilitate ready and rapid rise of the piston 25 and associated parts, large openings 26 in the piston-head 23 are provided. These openings are controlled by check-valve discs 27 which are loosely held in place by check-valve gages 28 having side openings around a large portion of their periphery.

Upon rise of piston 25, even at a rapid rate, little pneumatic restraint to movement occurs, due to the large size of the openings 26 and the ease with which valve discs 27 are raised from their seats.

To control descent of piston 25 and associated parts, say from the position in which they are shown in the drawings, a series of relief ports is provided. The initial rate of descent of piston 25 is principally dependent upon a large initial relief port 29, which permits air to escape quite freely until the same is closed by piston 25 itself. This part of the descent of piston 25 is quickly accomplished. After closing of port 29 further escape of air takes place at a much restricted rate through calibrated intermediate escape orifice 30. The intermediate escape orifice 30 is the predominant factor in regulating the total time of descent of piston 25, since it may be made small enough so that all but a very small part of the time consumed in the total downward excursion of piston 25 occurs after closing of port 29. As the piston 25 and piston-rod 21 approach the lower end of their downward excursion, a final relief port 31 in piston-rod 21 becomes uncovered beyond the lower end of guide-sleeve 24. Port 31 communicates with a central longitudinally extending bore in piston-rod 21, the upper end of which is in communication with re-entry port 32, as shown. The bore of guide-sleeve 24 above the lower constricted part thereof is substantially larger than the diameter of piston-rod 21, as is clearly shown in Figs. 1 and 4 and, as a consequence, upon the uncovering of final relief port 31 ready escape of air remaining in cylinder 22 is permitted and piston 25 and associated parts, including contact 19, drop rapidly for a short space until contacts 18 and 19 come into engagement.

The engaging of contacts 18 and 19 completes a circuit as follows: Contact 19 is in electrical connection with highly flexible spiral lead 33, which is brought to an insulating mounting 34 through which said lead passes to make electrical connection with primary lead 15, previously described. The other lead 14 of the primary connects with a hermetically sealed insulated lead-in 35, which passes through the base 2. From lead-in 35 the circuit passes through supply lead 36 to a source of electricity, such as a storage battery or a dry cell battery, and from thence back through supply lead 37 to a manual switch 38, which may be used to stop and start the apparatus. A short lead 39 extends from the other side of switch 38 to the hermetically sealed insulated lead-in 40 and from thence to a grounding connection with base 2. If desired, lead-in 40 may be dispensed with and connection of lead 39 made directly to base 2. From base 2 a direct electrical path leads to contact 18 through the armature 7 and its mounting, as previously explained. A condenser 42 is placed in shunt connection with the contacts 18 and 19 by a lead 43 connecting with flexible spiral lead 33 and by a lead 44 connecting with the armature 7 for the purpose of diminishing deterioration of contacts 18 and 19 in well-known manner.

The engagement of contacts 18 and 19 thus energizes the primary winding, which causes the armature 7 to be suddenly pulled upward, which movement imparts kinetic energy to piston-rod 21 and the attached piston 25, causing the same to rise to a position such, for example, as that shown in the drawings. This action is very fast. The piston 25 and associated parts then descend, as described above, to bring contacts 18 and 19 again into engagement, whereupon repetition of the cycle occurs in a manner to be continued indefinitely.

It will be noted that all stages of the piston cycle are accomplished quickly except the piston's intermediate descent under control of calibrated orifice 30. The parts of the cycle which are quickly accomplished thus consume only a small per cent of the total time required to complete a cycle. From this it follows that the rate or frequency of the apparatus will remain substantially constant regardless of the height to which the piston 25 rises, so long as the piston 25 is raised at least high enough to uncover initial escape port 29. It is thus possible to employ a battery which initially raises piston 25 as high or higher than the position shown in the draw-

ings. As the output of such a battery declines, the rise of piston 25 will accordingly diminish with only an imperceptible increase in the frequency of the cycle until the battery no longer has sufficient power to raise piston 25 beyond initial relief port 29. By the time the battery has reached such a condition, however, its useful life is largely spent and the substantial range of constancy of rate of the apparatus of this invention will be found ample from a practical standpoint.

To derive an impulse from the apparatus of this invention, suitable for charging a fence or actuating a signal, the secondary winding previously described is provided. Lead 16 of the secondary winding is for this purpose grounded on base 2 and lead 17 thereof, connected as shown to an hermetically sealed, insulating, high-tension bushing 49. Bushing 49 is composed of a recessed upper member 50 engaged by a lower male member 51 which passes upwardly through a large opening in base 2 into the upper member 50, as shown. The bushing 49 is held together by a bolt 52 which is cemented in place with a sealing cement and which pulls the parts together against sealing gaskets 53—53 of rubber or other suitable soft material thus providing an hermetically sealed high-tension lead-in.

To support the apparatus of this invention and to provide a mounting for the exterior parts thereof, a depending collar 55 is spot-welded or otherwise fastened to an up-turned rim 45, which is formed as a part of the base 2. Suitable grommets are provided in openings in collar 55 for the entrance of leads 36 and 37 and for high-tension lead 54, which connects with bolt 52. A ground connection for the apparatus may be made to binding post 58. A stiff hanging bracket 56 rises behind the apparatus, as shown in the drawings, and enters a slot in the rear of collar 55, from which it rises and engages the bottom of base 2 and then drops to furnish support for switch 38. Access to switch 38 is through an aperture in the front of collar 55. A bottom cover 59 may also be provided, as shown in Figs. 1 and 2.

To insure constancy of atmospheric conditions for the operating parts, an inverted cup-shaped glass cover 46 is placed upon base 2 within the up-turned rim 45 previously referred to. In the channel formed between the lower edges of cover 46 and the rim 45, a sealing composition of waxy or bituminous character is run in hot and allowed to cool, thus hermetically enclosing all operating parts of the unit. Before running in the sealing compound, clips 47—47 may be put in place and held by tamper-proof seals 48—48. In this manner the operating parts of the apparatus are sealed. Before sealing it is preferred to enclose an atmosphere of air or other gas of low humidity to impede corrosion of parts, deterioration of contacts, and breakdown of insulating materials. I have found that under ordinary barnyard or field conditions to which fence chargers are subjected that a very marked increase in the useful life of the unit is obtained by so filling and sealing the same. I have found, however, that due to the improvement in insulation in such a sealed unit filled with dry gas the slight leakage of condenser 42 which is ordinarily experienced is not obtained. Since this leakage is beneficial in certain respects in suppressing undesired sparking of the contacts, I propose to supply a predetermined amount of leakage through a fixed resistor 57 placed in shunt connection with condenser 42, as shown. A suitable value for such resistor is 500,000 ohms, although much larger or smaller resistance values may be employed with advantageous results.

From the foregoing it will be observed that an apparatus is provided which is dependable in its response and immune to the effects of changes in atmospheric conditions and that while a specific embodiment of the invention is illustrated and described, the advance in the art represented thereby is capable of embodiment in widely varying but equivalent forms. It is, therefore, intended that the protection of letters patent granted hereon be not unnecessarily limited by this description, but that the same shall extend to the limits of the inventive advance disclosed herein as set forth in the claims hereto appended.

That which I claim as my invention and wish to protect by Letters Patent is:

1. In an apparatus for producing time-spaced electrical impulses, the combination comprising means for displacement of fluid capable of outward and return strokes, means permitting free displacement of fluid by said displacement means during its outward stroke, means for restricting fluid displacement by said displacement means during a predetermined intermediate portion of the return stroke thereof, loading means acting upon said displacement means to urge the same in the return direction, a contact movable in outward and return direction under control of said displacement means, a second contact engageable by said first-named contact when the latter approaches the end of its return stroke and while the same is traveling free of the restraint of said intermediate restraining means, means for creating an electrical impulse actuated by said contacts, and electromagnetic means energized by engagement of said contacts adapted to impart kinetic energy to said displacement means to cause the same to move through its outward stroke against the action of said loading means until said imparted kinetic energy is stored by such loading means in form available to cause the return stroke of said displacement means, whereby said displacement means may be repetitively moved rapidly in the outward direction and under influence of said loading means and said fluid displacement restricting means slowly in the intermediate portion of its return stroke to produce approximately equally time-spaced electrical impulses.

2. In an apparatus for producing time-spaced electrical impulses, the combination comprising a dash-pot capable of outward and return strokes, means providing free displacement of fluid by said dash-pot during its outward stroke, means for restricting fluid displacement by said dash-pot during a predetermined intermediate portion of its return stroke, loading means acting upon said dash-pot to urge the same in the return direction, a contact movable in outward and return directions under control of said displacement means, a second contact engageable by said first-named contact when the latter approaches the end of its return movement and while the same is moving free of the restraint of said intermediate restraining means, means for creating an electrical impulse actuated by said contacts, and electromagnetic means energized by engagement of said contacts adapted to impart kinetic energy to said dash-pot to cause the same to move through its outward stroke against the action of said loading means

until said imparted kinetic energy is stored by said loading means in form available to cause the return stroke of said dash-pot, whereby said dash-pot may be repetitively moved rapidly in the outward direction and under influence of said loading and said fluid-displacement restricting means slowly in the intermediate portion of its return stroke to produce approximately equally time-spaced electrical impulses.

3. In an apparatus for producing time-spaced electrical impulses, the combination comprising a vertical cylinder, a piston slidably mounted to move vertically in said cylinder with an upward and a downward stroke, a piston-rod secured to said piston and extending downwardly therefrom to the outside of said cylinder, a check-valve in said cylinder for admitting air thereto upon upward movement of said piston, an initial air-escape port in said cylinder intermediate the ends of said cylinder to permit an initial free drop of said piston during its downward stroke, a relatively smaller intermediate air-escape port for regulating descent of said piston after said initial escape port is closed, a piston-controlled final escape port opened at the lower end of the stroke of said piston to permit a final free drop of said piston, a pair of contacts controlled by movement of said piston-rod and brought into engagement thereby at the lower end of the stroke thereof after opening of said final escape port, electromagnetic impact means energized by engagement of said contacts arranged to strike said piston-rod with sufficient force to cause said piston to rise above said initial escape port each time said contacts come into engagement, and means controlled by engagement of said contacts for creating an electrical impulse.

4. In an apparatus of the class described, the combination comprising a core of magnetic material, a primary winding surrounding said core for magnetizing the same, an armature positioned to be attracted by said core, a vertical cylinder having a cylinderhead and a piston-rod guide in its bottom, a piston slidably mounted for vertical movement in said cylinder, a depending piston-rod secured to said piston passing through and slidably received in said piston-rod guide in said cylinderhead, and positioned to receive an upward impact blow from said armature when the latter is attracted by said core, a check-valve in said cylinder for admitting air thereto during upward movement of said piston, an initial relief port in said cylinder closed by said piston in its lower positions for permitting ready escape of air from said cylinder during an initial downward movement of said piston, a restricted relief port for delaying descent of said piston after said initial relief port is closed, a passage in said piston-rod communicating with the interior of said cylinder and extending to the exterior when said piston approaches the end of its downward movement to provide a final relief port for ready escape of air permitting a final rapid descent of said piston, a contact carried by said piston-rod, a second contact carried by said armature positioned to be engaged by said first contact at the bottom of the stroke of said piston-rod, means for supplying electric current to said primary winding while said contacts are in engagement, and a secondary winding positioned to be energized by flux changes in said core.

5. In a timing device suitable for regulating electric interrupters and the like, the combination comprising a cylinder, a cylinderhead in one end of said cylinder, a piston-rod guiding-sleeve extending from said cylinderhead, a piston-rod movable in said guide, a piston movable in said cylinder mounted upon said piston-rod, loading means urging said piston toward said cylinderhead, a check-valve in said cylinderhead for admitting air, means for releasing air slowly from said cylinder during an early portion of the stroke of said piston toward said cylinder head and rapidly during a final portion of said stroke.

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